EC2600 Sample Exam Problems

1. A copper wire ($\sigma = 6.17 \times 10^7$ S/m) has a diameter of 0.6 inch, carries a current of 50 A, and is 1200 feet long. Find:
(a) The total resistance, R.
(b) The current density in the wire.
(c) The DC voltage between the conductor ends.
(d) The power dissipated in the wire.

2. Find the electric field intensity at $(x, y, z) = (2,5,0)$ on a perfect ground plane at $z=0$ due to a line charge of 30 nC/m parallel to the y axis and located at $(x, z) = (0,3)$.
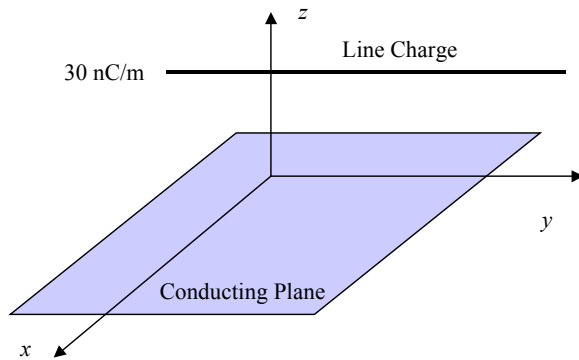
3. The potential in a region of space is given by $V(x, y) = 100(x^2 + y^2)$.
(a) What is the electric field in the region?
(b) Given that the point $P(x, y, z) = P(2, -1, 3)$ in this region is situated on a boundary between a conductor and air, what is the potential of the conductor surface?
(c) What is the magnitude of the surface charge density on the conductor?

4. An infinite sheet of charge $\rho_s = 100 \text{ C/m}^2$ is located in the $z = 0$ plane.
(a) What is the electric field intensity at the point $P(x, y, z) = P(0, 0, 10)$ on the z axis 10 m above the plane?
(b) What is the force on a 0.5 C charge at this distance?
(c) What is the potential difference between this point and $P(x, y, z) = P(2, -1, 3)$?

5. Convert the vector $\vec{A} = 10y\hat{z}$ to spherical coordinates.

6. The phasor form of the power density in an electromagnetic wave generated by a certain antenna is given by $\vec{W}(R, \theta, \phi) = \hat{R}\dfrac{2.5}{R^2}\sin\theta$ W/m^2. Find $\displaystyle\oint_{S_R} \vec{W} \bullet d\vec{s}$ over a spherical surface of radius R.